ENVIRONMENTAL SERVICE OF THE BOTANIC GARDEN CARLOS THAYS' TREES TO THE CITY OF BUENOS AIRES: CALCULATION OF TOTAL CARBON RETENTION, ANNUAL ABSORPTION OF CARBON DIOXIDE AND OXYGEN PRODUCTION

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Introduction

The objective of the measurements presented in this paper is the calculation of the environmental service by C retention of the arboreal specimens that make the living collection of the Botanical Garden of the City.

The value of a forest fixing and storing carbon is well known, although its meaning as an environmental service has only appeared when awareness of the role of CO2 emissions in climate change has prompted the signing of international agreements and the implementation of policies tending to reduce them (Ruiz Pérez et al., 2007)

An environmental service is provided to an ecosystem through different channels. In the case of trees, this service translates into the production of oxygen and the absorption of carbon dioxide - expected physiological processes of a vegetable - to which is added the capacity of fixation and tissue storage of atmospheric carbon for a length of time that depends on the size and longevity of the species and the management it receives (Barreiro 2007)

Carbon dioxide, the gas contributing to the greenhouse effect, is used by plants in the process of photosynthesis. The compound is "removed" from the atmosphere when it is sequestered by plants, transformed and stored in complex carbon molecules that structure the wood in the woody species.

One of the parameters that allows to know the amount of carbon stored inside a tree is the biomass while the foliar area allows among other things to determine the capacity of capture or retention of atmospheric particles harmful to health.

Biomass refers to the dry matter produced by the plants, expressed in terms of weight and referred to a certain surface area (t / ha). The accumulated biomass varies between roots, leaves, branches or trunk and depends on the age, the species, the site and the management.

The foliar area is associated with leaf biomass and refers to the integration of the area of all leaves present in an individual or system. The correspondence of this in relation to the unit of surface that sustains it, is known as index of leaf area (IAF). The extent to which trees intercept pollutants, precipitation and cool the air by evapotranspiration depends on the magnitude of the leaf surface.

For the calculations made in this work, the parameters established by the United States Forest Service (USFS) were used according to extensive research conducted in American universities, currently applied worldwide.

Method

Twenty-six plots were selected as samples, with dominion of woody species, both native and exotic.

In these areas, 215 trees of different sizes were measured. It was considered that the size of the sample gave enough data to infer the results of the whole site (the measured trees represent 17% of the total of the trees in the collection)

Because it is a botanical collection, the determination of biomass was carried out with a non-destructive method.

The classic method of calculating the biomass of the trunk is from the timber volume of each specimen, affected by the density of its wood. To estimate the corresponding to the rest of the aerial and underground tissues, an expansion factor is included in the calculation.

It is established that approximately 50% of the biomass is constituted by carbon and considering the molecular and atomic weights of the CO2 and C respectively, it is deduced that to obtain 1 tn of C, 3,667 tons of CO2 are needed, thus obtaining the total of dioxide of carbon sequestered.

On the other hand, to estimate the production of oxygen, the figure starts from the value of sequestered carbon and is related to the molecular and atomic weights of oxygen and carbon.

To determine the height of the trees, the Tangent Height Gauge instrument was used, proving to be comparatively more efficient than others (it measures distance to the tree with steps of standardized length for each operator)

The DAP (diameter at chest height) was measured with a flexible metric tape at 1.30 meters high, taking the conventions of international application for the measurement of inclined trees, with bifurcated axes and with inclination in terrains with slope.

- Inclined land: Measured by the upper part of the slope
- Tilted tree: Measured towards the side of the trunk inclination.
- Forked axles:
    - Bifurcation below the DAP, two different specimens are considered.
    - Bifurcation at the height of the DAP or higher, it is considered a single tree.
- Trees with root system in the air: measured from the neck of the root.

The specific weight and density of the wood were obtained from bibliographic data. In the case of the species without data, it was inferred by proximity in the botanical phylogeny.

Applied calculations:

-TOTAL BIOMASS (BT) arises from the following calculations:

-BASAL AREA (AB in m2) = π. * DAP2 / 4

-VOLUME (V in m3) = AB (m2) * h (m) * f (form factor 0.7)

-TOTAL BIOMASS (BT in tn / ha) = V (m3) * d (t / m3) * 1,6 expansion factor

-TOTAL CARBON (CT) = BT * 0.5 (50% of BT)

-CO2: The sequestration of carbon dioxide was obtained by relating the total carbon (CT) with the conversion factor that involves the molecular and atomic weights (CO2 / C = 3.667)

-PRODUCTION OF O2 (OT): From the carbon sequestered (CT), relating the molecular and atomic weights of O2 / C = 2,667

The whole set of measures can be seen in the file sheets attached to this report.

In the case of knowing the origin of the trees and the date of planting, further calculations could be made on the average annual rate of sequestration of C and compare the results with the oxygen consumption of the inhabitants and the production of carbon dioxide from the urban activities.

Conclusions

Although it is always conflicting to assign a monetary value to the environment, it becomes a pragmatic method to explain the value of the elements that make up the environmental system, particularly in urban conditions, when decisions are made based on the Return Rates of the Investment. .

Internationally, it is agreed to assign a value in dollars per ton of carbon sequestered and retained in the wood of trees, a value that has also become negotiable goods known as "carbon bonds".

Considering the values currently used (U$S 20 per ton of CO2 absorbed, U$S 50 per ton of C sequestered and retained), the Botanical Garden of the City would be offering an environmental service equivalent to U$S 159,140 (pesos at April 2018, $ 20.50 / dollar: $ 3,262,370) in absorbed CO2 and U$S 108,140 ($ 2,216,880) in retained C.

If the other lines of the environmental service of a wooded property were added to an urban area (particle removal, rainwater retention and energy saving due to the reduction of extreme temperatures), an additional international price of U$S 150 was agreed for an average size tree. This would mean a contribution to the environment by the Botanic Garden, only considering the service of their trees, of additional U$S 195,000 ($ 3,997,500)

All contributions must be considered on an annual basis.

Annual media governmental investment in the BG

	pesos	dollars
Uniforms and clothing	250000	12195
Cash of free management	140000	6830
Infrastructure work and maintenance	1000000	48780
Office supplies and devices	30000	1500
Gardening supplies	150000	7315
Salaries	19500000	951220
Security service	1500000	8300
TOTAL		**1.036.140**

	Annual expenses or income (dollars)
Total expenses	**1.036.140**
Production in terms of CO2 absorption	159.140
Production in terms of C storage	108.140
Production in terms of other environmental services (PM retention, energy saving, etc.)	195.000
Total produced in terms of ES	**462.280**

In conclusion, for every dollar invested by the public in the BG, it gives them back almost 50 cents, just in clean air.

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Results for the 215 evaluated trees

Cantero	ID	Nombre Científico	CIRCUNF (m)	DAP (m)	AB (m2)	H (m)	vol (m3)	d (t/m3)	BIOMASA (t)	Carbono (t)	CO2 (t)	O2 (t)
87	805	Cupressus sempervirens	0,91	0,290	0,066	15,000	0,692	0,600	0,665	0,332	1,219	0,886
87	806	Juniperus chinensis	0,68	0,217	0,037	6,000	0,155	0,440	0,109	0,054	0,200	0,145
87	802	Araucaria cunninghamiana	0,67	0,213	0,036	12,000	0,300	0,500	0,240	0,120	0,440	0,320
87	2481	Pinus cembroides	1,3	0,414	0,135	14,000	1,319	0,600	1,266	0,633	2,321	1,688
88	810	Araucaria bidwilii	3,45	1,099	0,948	30,000	19,901	0,450	14,328	7,164	26,271	19,107
88	809	Araucaria angustifolia	1,62	0,516	0,209	17,000	2,486	0,500	1,989	0,995	3,647	2,653
88	811	Araucaria columnaris	2,11	0,672	0,354	32,000	7,940	0,500	6,352	3,176	11,646	8,470
88	2501	Platycladus orientalis	1,07	0,341	0,091	10,000	0,638	0,440	0,449	0,225	0,824	0,599
88	816	Ginkgo biloba	2,25	0,717	0,403	18,000	5,079	0,420	3,413	1,706	6,257	4,551
88	808	Agathis robusta	3,07	0,978	0,750	35,000	18,385	0,540	15,884	7,942	29,124	21,182
88	449	Cryptomeria japonica	0,6	0,191	0,029	15,000	0,301	0,400	0,193	0,096	0,353	0,257
89	818	Araucaria heterophyla	1,1	0,350	0,096	18,000	1,214	0,500	0,971	0,486	1,780	1,295
89	829	Juniperus comunis	0,26	0,083	0,005	6,000	0,023	0,440	0,016	0,008	0,029	0,021
89	831	Sequoia sempervirens	2,32	0,739	0,429	28,000	8,399	0,430	5,779	2,889	10,595	7,706
89	830	Juniperus virginiana	0,45	0,143	0,016	6,000	0,068	0,440	0,048	0,024	0,087	0,064
89	826	Cupressus torulosa	0,29	0,092	0,007	6,000	0,028	0,500	0,022	0,011	0,041	0,030
89	823	Cupressus goveniana	0,68	0,217	0,037	10,000	0,258	0,500	0,206	0,103	0,378	0,275
89	824	Cupressus arizonica	1,73	0,551	0,238	16,000	2,669	0,500	2,135	1,068	3,915	2,847
89	827	Juniperus chinensis	0,72	0,229	0,041	8,000	0,231	0,440	0,163	0,081	0,298	0,217
90	832	Taxodium distichum	2,17	0,691	0,375	18,000	4,724	0,510	3,855	1,927	7,068	5,140
90	832	Taxodium distichum	2,17	0,691	0,375	18,000	4,724	0,510	3,855	1,927	7,068	5,140
91	836	Cupressus lusitanica	1,37	0,436	0,149	22,000	2,301	0,480	1,767	0,884	3,241	2,357
91	835	Cryptomeria japonica	0,85	0,271	0,058	15,000	0,604	0,400	0,387	0,193	0,709	0,515
91	833	Agathis robusta	3,04	0,968	0,736	35,000	18,027	0,540	15,575	7,788	28,557	20,770
91	2503	Cedrus deodara	2,45	0,780	0,478	25,000	8,363	0,560	7,494	3,747	13,739	9,993
92	841	Pinus pinaster	1,21	0,385	0,117	15,000	1,224	0,600	1,175	0,588	2,154	1,567
92	840	Pinus wallichiana /griffithii	0,31	0,099	0,008	6,000	0,032	0,600	0,031	0,015	0,057	0,041
92	842	Pinus roxburghii	2,27	0,723	0,410	22,000	6,318	0,600	6,065	3,033	11,121	8,088
92	839	Cryptomeria japonica	0,93	0,296	0,069	14,000	0,675	0,400	0,432	0,216	0,792	0,576
93	846	Araucaria bidwilii	1,35	0,430	0,145	17,000	1,727	0,450	1,243	0,622	2,279	1,658
93	844	Aghatis robusta	1,33	0,424	0,141	25,000	2,465	0,540	2,129	1,065	3,904	2,840
93	847	Ginkgo biloba	0,87	0,277	0,060	18,000	0,759	0,420	0,510	0,255	0,936	0,680
93	847	Ginkgo biloba	0,74	0,236	0,044	18,000	0,549	0,420	0,369	0,185	0,677	0,492
93	845	Araucaria balansae	0,57	0,182	0,026	9,000	0,163	0,500	0,130	0,065	0,239	0,174
93	850	Thuja orientalis	0,64	0,204	0,033	10,000	0,228	0,440	0,161	0,080	0,295	0,214

Cantero	ID	Nombre Científico	CIRCUNF (m)	DAP (m)	AB (m2)	H (m)	vol (m3)	d (t/m3)	BIOMASA (t)	Carbono (t)	CO2 (t)	O2 (t)
94	890	Pinus caribaea	2,1	0,669	0,351	30,000	7,373	0,510	6,017	3,008	11,032	8,023
94	853	Cupressus lusitanica	0,88	0,280	0,062	18,000	0,777	0,480	0,597	0,298	1,094	0,796
94	1095	Pinus thunberghii	2,11	0,672	0,354	30,000	7,444	0,600	7,146	3,573	13,102	9,529
94	854	Pinus halepensis	2,88	0,917	0,660	27,000	12,481	0,600	11,982	5,991	21,969	15,978
94	851	Araucaria excelsa	0,6	0,191	0,029	10,000	0,201	0,500	0,161	0,080	0,294	0,214
94	856	Taxodium mucronatum	2,04	0,650	0,331	15,000	3,479	0,510	2,839	1,419	5,205	3,786
94	855	Pinus roxburghii	0,84	0,268	0,056	15,000	0,590	0,600	0,566	0,283	1,038	0,755
96	10584	Ceiba speciosa	2,61	0,831	0,542	26,000	9,871	0,260	4,106	2,053	7,529	5,476
96	2495	Ceiba speciosa	2,98	0,949	0,707	17,000	8,414	0,260	3,500	1,750	6,417	4,667
96	859	Cedrus atlantica	1,98	0,631	0,312	24,000	5,244	0,560	4,698	2,349	8,615	6,265
96	858	Araucaria angustifolia	1,17	0,373	0,109	17,000	1,297	0,500	1,038	0,519	1,902	1,384
96	11587	Cedrus atlantica	1,88	0,599	0,281	18,000	3,546	0,560	3,177	1,588	5,825	4,236
95	857	Taxodium distichum	1,52	0,484	0,184	17,000	2,189	0,510	1,786	0,893	3,275	2,382
101	1604	Robinia pseudoacacia	1,1	0,350	0,096	18,000	1,214	0,760	1,476	0,738	2,706	1,968
101	1111	Robinia pseudoacacia	1,85	0,589	0,272	18,000	3,433	0,760	4,175	2,088	7,655	5,567
101	2522	Robinia pseudoacacia	1	0,318	0,080	14,000	0,780	0,760	0,949	0,474	1,740	1,265
101	2521	Robinia pseudoacacia	1,74	0,554	0,241	18,000	3,037	0,760	3,693	1,847	6,772	4,925
101	6266	Jacaranda mimosifolia	1,35	0,430	0,145	18,000	1,828	0,590	1,726	0,863	3,164	2,302
101	1087	Casuarina cunninghamiana	2,27	0,723	0,410	25,000	7,180	0,830	9,535	4,767	17,482	12,714
101	1086	Casuarina cunninghamiana	1,72	0,548	0,236	25,000	4,122	0,830	5,474	2,737	10,037	7,300
101	1085	Casuarina cunninghamiana	2,84	0,904	0,642	25,000	11,238	0,830	14,924	7,462	27,363	19,901
101	2638	Eugenia uniflora	0,68	0,217	0,037	12,000	0,309	0,820	0,406	0,203	0,744	0,541
101	2638	Eugenia uniflora	0,48	0,153	0,018	12,000	0,154	0,820	0,202	0,101	0,371	0,270
101	2638	Eugenia uniflora	0,48	0,153	0,018	12,000	0,154	0,820	0,202	0,101	0,371	0,270
101	2638	Eugenia uniflora	1,02	0,325	0,083	12,000	0,696	0,820	0,913	0,456	1,674	1,217
102	1125	Ceiba aescutifolia	1,12	0,357	0,100	17,000	1,188	0,260	0,494	0,247	0,906	0,659
103	9012	Ceiba crispiflora	0,14	0,045	0,002	2,500	0,003	0,260	0,001	0,001	0,002	0,002
103	1244	Cedrus deodara	3,12	0,994	0,775	26,000	14,106	0,560	12,639	6,319	23,173	16,854
103	1167	Ceiba speciosa	3,25	1,035	0,841	21,000	12,362	0,260	5,143	2,571	9,429	6,858
104	1207	Prosopis chilensis	1,63	0,519	0,212	12,000	1,777	0,740	2,104	1,052	3,857	2,805
104	1204	Ceiba speciosa	1,88	0,599	0,281	17,000	3,349	0,260	1,393	0,697	2,554	1,858
104	1205	Ceiba speciosa	1,69	0,538	0,227	16,000	2,547	0,260	1,059	0,530	1,943	1,413
104	1203	Ceiba speciosa	1,28	0,408	0,130	15,000	1,370	0,260	0,570	0,285	1,045	0,760
104	9011	Seiba crispiflora	0,64	0,204	0,033	9,000	0,205	0,260	0,085	0,043	0,157	0,114
104	1216	Schinus fasciculatus	0,33	0,105	0,009	5,000	0,030	0,650	0,032	0,016	0,058	0,042
104	1216	Schinus fasciculatus	0,36	0,115	0,010	5,000	0,036	0,650	0,038	0,019	0,069	0,050
104	1216	Schinus fasciculatus	0,68	0,217	0,037	5,000	0,129	0,650	0,134	0,067	0,246	0,179
104	1216	Schinus fasciculatus	0,38	0,121	0,011	5,000	0,040	0,650	0,042	0,021	0,077	0,056
104	1216	Schinus fasciculatus	0,29	0,092	0,007	5,000	0,023	0,650	0,024	0,012	0,045	0,033
104	1213	Prosopis alba	1,06	0,338	0,089	9,000	0,564	0,760	0,685	0,343	1,257	0,914

Cantero	ID	Nombre Científico	CIRCUNF (m)	DAP (m)	AB (m2)	H (m)	vol (m3)	d (t/m3)	BIOMASA (t)	Carbono (t)	CO2 (t)	O2 (t)
104	9095	Prosopis alpataco	0,11	0,035	0,001	2,500	0,002	0,780	0,002	0,001	0,004	0,003
104	9011	Ceiba crispiflora	0,64	0,204	0,033	9,000	0,205	0,260	0,085	0,043	0,157	0,114
104	1203	Ceiba speciosa	1,28	0,408	0,130	15,000	1,370	0,260	0,570	0,285	1,045	0,760
104	1205	Ceiba speciosa	1,69	0,538	0,227	16,000	2,547	0,260	1,059	0,530	1,943	1,413
104	1204	Ceiba speciosa	1,88	0,599	0,281	17,000	3,349	0,260	1,393	0,697	2,554	1,858
105	1255	Ceiba speciosa	2,16	0,688	0,371	18,000	4,680	0,260	1,947	0,974	3,570	2,596
106	1237	Quercus palustris	2,95	0,939	0,693	25,000	12,125	0,670	12,998	6,499	23,832	17,333
106	1236	Quercus macrocarpa	2,72	0,866	0,589	26,000	10,721	0,710	12,179	6,089	22,329	16,240
106	2526	Quercus palustris	1,58	0,503	0,199	25,000	3,478	0,670	3,729	1,864	6,837	4,972
106	1234	Quercus cerris	2,78	0,885	0,615	24,000	10,337	0,710	11,743	5,872	21,531	15,660
106	1259	Carpinus betulus	0,7	0,223	0,039	8,000	0,218	0,800	0,280	0,140	0,513	0,373
106	1238	Quercus robur	3,18	1,013	0,805	24,000	13,526	0,710	15,366	7,683	28,173	20,490
106	1241	Ulmus procera	0,83	0,264	0,055	10,000	0,384	0,550	0,338	0,169	0,619	0,451
106	2524	Ulmus sp	2,33	0,742	0,432	25,000	7,564	0,650	7,867	3,933	14,424	10,490
106	1240	Ulmus sp	2,8	0,892	0,624	25,000	10,924	0,650	11,361	5,680	20,829	15,149
106	1233	Quercus bicolor	2,13	0,678	0,361	22,000	5,563	0,670	5,963	2,982	10,934	7,952
107	5835	Ceiba speciosa	1,51	0,481	0,182	16,000	2,033	0,260	0,846	0,423	1,551	1,128
107	5843	Ceiba speciosa	3,2	1,019	0,815	20,000	11,414	0,260	4,748	2,374	8,706	6,332
107	5836	Ceiba speciosa	2,61	0,831	0,542	20,000	7,593	0,260	3,159	1,579	5,792	4,212
107	5833	Cedrela tubiflora	1,75	0,557	0,244	20,000	3,414	0,550	3,004	1,502	5,508	4,006
108	1282	Tilia moltkei	2,1	0,669	0,351	18,000	4,424	0,550	3,893	1,947	7,138	5,192
108	1633	Cupressus sempervirens	1,54	0,490	0,189	25,000	3,304	0,600	3,172	1,586	5,816	4,230
108	8740	Cupressus sempervirens	1,08	0,344	0,093	18,000	1,170	0,600	1,123	0,562	2,060	1,498
108	8741	Cupressus sempervirens	0,72	0,229	0,041	25,000	0,722	0,600	0,693	0,347	1,271	0,925
108	1603	Eugenia uniflora	0,38	0,121	0,011	8,000	0,064	0,800	0,082	0,041	0,151	0,110
108	1603	Eugenia uniflora	0,32	0,102	0,008	8,000	0,046	0,800	0,058	0,029	0,107	0,078
109	5849	Cedrela fissilis	1,75	0,557	0,244	24,000	4,096	0,500	3,277	1,639	6,009	4,370
110	2555	Quercus suber	1,86	0,592	0,275	18,000	3,471	0,900	4,998	2,499	9,163	6,664
110	1363	Quercus robur	3,5	1,115	0,975	26,000	17,751	0,740	21,017	10,508	38,535	28,026
110	1325	Cupressus torulosa	1,1	0,350	0,096	28,000	1,888	0,480	1,450	0,725	2,659	1,934
110	1344	Magnolia grandiflora	1,43	0,455	0,163	17,000	1,937	0,560	1,736	0,868	3,183	2,315
110	1344	Magnolia grandiflora	1,56	0,497	0,194	17,000	2,306	0,560	2,066	1,033	3,788	2,755
110	2552	Cupressus torulosa	2	0,637	0,318	28,000	6,242	0,480	4,794	2,397	8,790	6,393
110	1321	Quercus robur	1,55	0,494	0,191	20,000	2,678	0,740	3,171	1,585	5,813	4,228
110	1366	Quercus robur	2,12	0,675	0,358	20,000	5,010	0,740	5,931	2,966	10,875	7,910
110	1324	Ulmus minor	2,12	0,675	0,358	15,000	3,757	0,550	3,306	1,653	6,062	4,409
110	1329	Ulmus minor	3,58	1,140	1,020	30,000	21,429	0,550	18,857	9,429	34,575	25,146
110	2553	Quercus suber	1,87	0,596	0,278	18,000	3,508	0,900	5,052	2,526	9,262	6,736
110	379	Ulmus sp	1,21	0,385	0,117	16,000	1,306	0,550	1,149	0,574	2,107	1,532
110	1324	Ulmus minor	0,74	0,236	0,044	15,000	0,458	0,550	0,403	0,201	0,739	0,537

Cantero	ID	Nombre Científico	CIRCUNF (m)	DAP (m)	AB (m2)	H (m)	vol (m3)	d (t/m3)	BIOMASA (t)	Carbono (t)	CO2 (t)	O2 (t)
110	1359	Quercus ilex	0,83	0,264	0,055	18,000	0,691	0,960	1,062	0,531	1,946	1,416
110	2554	Quercus suber	1,84	0,586	0,270	18,000	3,396	0,900	4,891	2,445	8,967	6,522
110	1539	Quercus ilex	0,45	0,143	0,016	18,000	0,203	0,960	0,312	0,156	0,572	0,416
110	1539	Quercus ilex	0,32	0,102	0,008	18,000	0,103	0,960	0,158	0,079	0,289	0,210
110	1539	Quercus ilex	0,18	0,057	0,003	18,000	0,033	0,960	0,050	0,025	0,092	0,067
110	1364	Quercus robur	1,19	0,379	0,113	15,000	1,184	0,740	1,402	0,701	2,570	1,869
110	1361	Ulmus procera	3,48	1,108	0,964	30,000	20,248	0,550	17,818	8,909	32,670	23,761
110	1313	Ulmus procera	2,12	0,675	0,358	16,000	4,008	0,550	3,527	1,763	6,466	4,703
112	1380	Cedrela tubiflora	1,34	0,427	0,143	15,000	1,501	0,550	1,321	0,660	2,422	1,762
113	1399	Fraxinus excelsior	0,86	0,274	0,059	16,000	0,660	0,680	0,718	0,359	1,316	0,957
113	1399	Fraxinus excelsior	0,74	0,236	0,044	16,000	0,488	0,680	0,531	0,266	0,974	0,708
115	2580	Platanus acerifolia	2,74	0,873	0,598	30,000	12,553	0,600	12,050	6,025	22,094	16,069
115	2581	Platanus acerifolia	1,99	0,634	0,315	30,000	6,621	0,600	6,356	3,178	11,654	8,476
115	2582	Platanus acerifolia	1,98	0,631	0,312	30,000	6,555	0,600	6,293	3,146	11,538	8,391
115	2583	Platanus acerifolia	2,22	0,707	0,392	30,000	8,240	0,600	7,911	3,955	14,504	10,549
133	2026	Anadenantera colubrina	1,13	0,360	0,102	20,000	1,423	0,900	2,050	1,025	3,758	2,733
133	2028	Caesalpinia paraguariensis	1,28	0,408	0,130	12,000	1,096	1,180	2,069	1,034	3,793	2,759
133	867	Citronella mucronata	0,2	0,064	0,003	4,000	0,009	0,600	0,009	0,004	0,016	0,011
133	2031	Cupania vernalis	0,72	0,229	0,041	10,000	0,289	0,740	0,342	0,171	0,627	0,456
133	866	Eugenia myrcianthes	1,17	0,373	0,109	16,000	1,221	0,750	1,465	0,732	2,686	1,953
133	2065	Handroanthus impetiginosa	0,42	0,134	0,014	8,000	0,079	1,020	0,128	0,064	0,235	0,171
133	2035	Jacaranda mimosifolia	1,2	0,382	0,115	17,000	1,364	0,590	1,288	0,644	2,361	1,717
133	236	Jacaranda mimosifolia	1,26	0,401	0,126	17,000	1,504	0,590	1,420	0,710	2,603	1,893
133	2037	Jacaranda mimosifolia	0,97	0,309	0,075	17,000	0,891	0,590	0,842	0,421	1,543	1,122
133	2038	Jacaranda mimosifolia	1,15	0,366	0,105	17,000	1,253	0,590	1,183	0,591	2,169	1,577
133	2039	Jacaranda mimosifolia	1,2	0,382	0,115	17,000	1,364	0,590	1,288	0,644	2,361	1,717
133	2042	Myrcianthes pungens	0,74	0,236	0,044	12,000	0,366	0,850	0,498	0,249	0,913	0,664
133	2048	Parapiptadenia excelsa	3,62	1,153	1,043	25,000	18,259	0,880	25,708	12,854	47,136	34,282
133	2045	Parapiptadenia excelsa	2,18	0,694	0,378	28,000	7,416	0,880	10,442	5,221	19,145	13,924
133	906	Parapiptadenia excelsa	1,85	0,589	0,272	18,000	3,433	0,880	4,834	2,417	8,864	6,446
133	2049	Parapiptadenia rigida	2	0,637	0,318	23,000	5,127	0,980	8,040	4,020	14,741	10,721
133	913	Podocarpus macrophyllus	0,38	0,121	0,011	5,000	0,040	0,600	0,039	0,019	0,071	0,052
133	872	Podocarpus macrophyllus	0,27	0,086	0,006	4,500	0,018	0,600	0,018	0,009	0,032	0,023
133	912	Podocarpus macrophyllus	2,64	0,841	0,555	35,000	13,595	0,600	13,051	6,526	23,930	17,404
133	2056	Podocarpus macrophyllus	1,82	0,580	0,264	31,000	5,723	0,600	5,494	2,747	10,073	7,326
133	2055	Podocarpus macrophyllus	2,48	0,790	0,490	35,000	11,997	0,600	11,517	5,759	21,117	15,358
133	876	Podocarpus macrophyllus	2,68	0,854	0,572	35,000	14,010	0,600	13,450	6,725	24,660	17,935
133	911	Poecilanthe parviflora	0,26	0,083	0,005	5,000	0,019	0,700	0,021	0,011	0,039	0,028
133	881	Ruprechtia apetala	0,45	0,143	0,016	4,000	0,045	0,750	0,054	0,027	0,099	0,072

	ID	Nombre Científico	CIRCUNF (m)	DAP (m)	AB (m2)	H (m)	vol (m3)	d (t/m3)	BIOMASA (t)	Carbono (t)	CO2 (t)	O2 (t)
133	871	Ruprechtia apetala	0,23	0,073	0,004	5,000	0,015	0,750	0,018	0,009	0,032	0,024
133	2062	Scutia buxifolia	0,38	0,121	0,011	8,000	0,064	1,050	0,108	0,054	0,198	0,144
133	2061	Scutia buxifolia	0,22	0,070	0,004	6,000	0,016	1,050	0,027	0,014	0,050	0,036
133	2064	Solanum granuloso-leprosum	0,41	0,131	0,013	8,000	0,075	0,370	0,044	0,022	0,081	0,059
133	12158	Terminalia triflora	1,24	0,395	0,122	15,000	1,285	0,900	1,851	0,925	3,394	2,468
133	2070	Terminalia triflora	0,43	0,137	0,015	6,000	0,062	0,900	0,089	0,045	0,163	0,119
133	897	Terminalia triflora	0,23	0,073	0,004	5,000	0,015	0,900	0,021	0,011	0,039	0,028
133	2074	Terminalia triflora	0,54	0,172	0,023	10,000	0,163	0,900	0,234	0,117	0,429	0,312
133	2077	Tipuana tipu	3,24	1,032	0,836	35,000	20,477	0,680	22,279	11,139	40,849	29,709
136	2253	Jacaranda mimosifolia	1,34	0,427	0,143	16,000	1,601	0,590	1,512	0,756	2,771	2,016
136	931	Lonchocarpus muehlberghianus	2,4	0,764	0,459	24,000	7,704	0,720	8,876	4,438	16,273	11,836
136	2263	Peltophorum dubium	3,47	1,105	0,959	38,000	25,501	0,850	34,681	17,340	63,587	46,247
136	2256	Luehea divaricata	1,31	0,417	0,137	15,000	1,435	0,600	1,377	0,689	2,525	1,837
136	2240	Chrysophyllum gonocarpun	0,53	0,169	0,022	8,000	0,125	0,800	0,160	0,080	0,294	0,214
136	2202	Pilocarpus pennatifolius	0,52	0,166	0,022	7,000	0,105	1,030	0,174	0,087	0,319	0,232
136	2245	Erythrina falcata	1,75	0,557	0,244	18,000	3,072	0r fvbcb,240	1,180	0,590	2,163	1,573
136	2273	Tipuana tipu	3,25	1,035	0,841	20,000	11,773	0,680	12,810	6,405	23,486	17,082
136	2239	Chrysophyllum gonocarpum	0,58	0,185	0,027	12,000	0,225	0,800	0,288	0,144	0,528	0,384
136	946	Eugenia uniflora	1,74	0,554	0,241	12,000	2,025	0,990	3,207	1,604	5,881	4,277
136	2276	Vitex megapotanicum	0,28	0,089	0,006	10,000	0,044	0,800	0,056	0,028	0,103	0,075
136	1455	Myrocarpus frondosus	1,1	0,350	0,096	25,000	1,686	0,845	2,279	1,140	4,179	3,040
136	2233	Myrocarpus frondosus	0,65	0,207	0,034	14,000	0,330	0,845	0,446	0,223	0,817	0,594
136	2233	Myrocarpus frondosus	0,43	0,137	0,015	14,000	0,144	0,845	0,195	0,098	0,358	0,260
136	2233	Myrocarpus frondosus	0,6	0,191	0,029	14,000	0,281	0,845	0,380	0,190	0,696	0,506
136	2262	Myrocarpus frondosus	1,12	0,357	0,100	25,000	1,748	0,845	2,363	1,181	4,333	3,151
136	936	Parapiptadenia excelsa	0,89	0,283	0,063	21,000	0,927	0,978	1,451	0,725	2,660	1,934
136	936	Parapiptadenia excelsa	1,08	0,344	0,093	21,000	1,365	0,978	2,136	1,068	3,917	2,849
136	2257	Machaerium paraguariensis	1,17	0,373	0,109	22,000	1,678	0,690	1,853	0,926	3,397	2,471
136	2257	Machaerium paraguariensis	1,24	0,395	0,122	22,000	1,885	0,690	2,081	1,041	3,816	2,775
136	2274	Trichilia elegans	0,34	0,108	0,009	6,000	0,039	0,770	0,048	0,024	0,087	0,064
136	2274	Trichilia elegans	0,26	0,083	0,005	6,000	0,023	0,770	0,028	0,014	0,051	0,037
136	2274	Trichilia elegans	0,2	0,064	0,003	6,000	0,013	0,770	0,016	0,008	0,030	0,022
136	2243	Citharexylum montevidense	1,49	0,475	0,177	18,000	2,227	0,720	2,566	1,283	4,704	3,421
136	2247	Eugenia uniflora	0,5	0,159	0,020	12,000	0,167	0,990	0,265	0,132	0,486	0,353
136	2247	Eugenia uniflora	0,72	0,229	0,041	12,000	0,347	0,990	0,549	0,275	1,007	0,732
136	2247	Eugenia uniflora	0,43	0,137	0,015	12,000	0,124	0,990	0,196	0,098	0,359	0,261
136	2247	Eugenia uniflora	0,25	0,080	0,005	12,000	0,042	0,990	0,066	0,033	0,121	0,088

Cantero	ID	Nombre Científico	CIRCUNF (m)	DAP (m)	AB (m2)	H (m)	vol (m3)	d (t/m3)	BIOMASA (t)	Carbono (t)	CO2 (t)	O2 (t)
136	2247	Eugenia uniflora	0,24	0,076	0,005	12,000	0,039	0,990	0,061	0,031	0,112	0,081
136	2247	Eugenia uniflora	0,44	0,140	0,015	12,000	0,129	0,990	0,205	0,103	0,376	0,273
136	2247	Eugenia uniflora	0,37	0,118	0,011	12,000	0,092	0,990	0,145	0,073	0,266	0,193
136	2254	Lonchocarpus leucanthus	0,43	0,137	0,015	19,000	0,196	0,890	0,279	0,139	0,511	0,372
136	2254	Lonchocarpus leucanthus	0,5	0,159	0,020	19,000	0,265	0,890	0,377	0,188	0,691	0,503
136	2254	Lonchocarpus leucanthus	0,5	0,159	0,020	19,000	0,265	0,890	0,377	0,188	0,691	0,503
136	2254	Lonchocarpus leucanthus	0,55	0,175	0,024	19,000	0,320	0,890	0,456	0,228	0,836	0,608
136	2255	Lonchocarpus leucanthus	0,61	0,194	0,030	19,000	0,394	0,890	0,561	0,281	1,029	0,748
136	2255	Lonchocarpus leucanthus	0,34	0,108	0,009	19,000	0,122	0,890	0,174	0,087	0,320	0,232
136	2255	Lonchocarpus leucanthus	0,33	0,105	0,009	19,000	0,115	0,890	0,164	0,082	0,301	0,219
136	2255	Lonchocarpus leucanthus	0,3	0,096	0,007	19,000	0,095	0,890	0,136	0,068	0,249	0,181
136	2255	Lonchocarpus leucanthus	0,28	0,089	0,006	19,000	0,083	0,890	0,118	0,059	0,217	0,158
136	1384	Aspidosperma australe	1,04	0,331	0,086	22,000	1,326	0,765	1,623	0,812	2,976	2,165
136	1384	Aspidosperma australe	0,59	0,188	0,028	22,000	0,427	0,765	0,522	0,261	0,958	0,697
136	2233	Myrocarpus frondosus	0,45	0,143	0,016	22,000	0,248	0,845	0,336	0,168	0,615	0,448
141	2831	Juglans microcarpa	0,69	0,220	0,038	9,000	0,239	0,640	0,245	0,122	0,448	0,326
141	1434	Liquidambar styraciflua	1,75	0,557	0,244	20,000	3,414	0,560	3,059	1,529	5,608	4,079
141	1424	Cupressus sempervirens	1,28	0,408	0,130	28,000	2,557	0,600	2,454	1,227	4,500	3,273
141	1456	Tilia tomentosa	2,2	0,701	0,385	26,000	7,013	0,550	6,172	3,086	11,316	8,230
141	2839	Tilia moltkei	1,09	0,347	0,095	18,000	1,192	0,550	1,049	0,524	1,923	1,399
141	2573	Liquidambar styraciflua	1,71	0,545	0,233	25,000	4,074	0,560	3,650	1,825	6,693	4,868
141	2847	Tilia moltkei	1,22	0,389	0,119	20,000	1,659	0,550	1,460	0,730	2,677	1,947
141	1444	Peltophorum dubium	1,8	0,573	0,258	25,000	4,514	0,850	6,139	3,070	11,257	8,187
Media values			**1,34**	**0,427**	**0,143**	**17,061**	**3,445**	**0,656**	**3,327**	**1,664**	**6,101**	**4,437**
Total									**705,499**	**352,750**	**1293,533**	**940,783**

Inferred results for the whole site:

	CIRCUNF (m)	DAP (m)	AB (m2)	H (m)	vol (m3)	d (t/m3)	BIOMASA (t)	Carbono (t)	CO2 (t)	O2 (t)
Media values	**1,344**	**0,427**	**0,143**	**17,061**	**3,445**	**0,656**	**3,327**	**1,664**	**6,101**	**4,437**
Total for 215 individuals							**705,499**	**352,750**	**1293,533**	**940,783**
Total for 1300 individuals							***4325,621***	***2162,810***	***7931,026***	***5768,215***